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Research Article

TECTONIC-STATISTICAL METALLOGENIC ANALYSIS ON THE EXAMPLE OF ZIRABULAK-ZIAETDIN REGION (SOUTHERN TIEN SHAN, UZBEKISTAN)

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ABSTRACT
The article considers the application of statistical metallogenic analysis in relation to the tectonic structure and patterns of distribution of ore deposits. The ore content of the region is determined by the placement of such minerals as gold, silver, tungsten, tin, uranium, copper, etc.

Key Words: *Zirabulak-Ziyaetdin Mountains, Southern Tien Shan, faults, Ore potential*

INTRODUCTION

Metallogeny as a theory of the patterns of formation and distribution of mineral deposits in space is a link between fundamental and applied geological research and has a practical focus.

The formulation of the general laws and principles of metallogeny were given in the works of F.A. Usmanov - "... the metallogeny of regions is a consequence of the history of their geodynamic regimes and can turn it from a descriptive and empirical science into a theoretically developed science with quantitative models on a mathematical, physical and chemical basis" (Usmanov, 2005). Based on the foregoing, it is advisable to use the methods of mathematical statistics for regional metallogenic analysis. Metallogenic analysis by methods of mathematical statistics includes a set of statistical and probabilistic methods and a set of statistical regularities themselves. It studies the connections between ore deposits and other geological objects. The number of such objects studied in regional metallogeny is usually in the hundreds or thousands, that is, it represents a statistical totality, therefore the relationships are probabilistic-statistical in themselves. (Usmanov, 2005; Usmanov, 2002).

MATERIALS AND METHODS

Geomorphologically, the Zirabulak-Ziaetdin mountains are the northwestern continuation of the Zerafshan ridge of the Southern Tien Shan and are separated from other mountain structures: in the north - by the Zerafshan depression (the thickness of the Mesozoic-Cainozoic deposits reaches 2 km); in the south - the Dzhan and Karnab plains; in the west - Bukhara depression.

The geological structure of the Zirabulak-Ziaetdin region includes Paleozoic, Mesozoic and Cenozoic formations. The Paleozoic basement is composed of sedimentary-metamorphic formations intruded mainly by granitoid rocks (Bukharin *et al.*, 1989). They are more or less subject to regional and contact metamorphism, with the formation of various shales, hornfelses and marbles. In addition, as a result of folded processes, they are significantly dislocated and complicated by ruptures. As is known, it is precisely such rock areas that are tectonically disturbed and transformed by hypogene and hypergene processes that are favorable positions for the placement of ore minerals (Ore deposits of Uzbekistan, 2001; Kustarnikova, 2012).

In geological and structural terms, the area is an alternation of anticlinorian and synclinorian structures, elongated in the sublatitudinal direction and complicated by higher-order folds. They are fault folds of shear zones of sublatitudinal west-northwest strike.

Ore-bearing formations are combined into five volcanogenic-sedimentary formations according to the frequency of occurrence, relationships, occurrence features, similarity of formation age and material composition: 1) carbonate-effusive-terrigenous O_{2-3}-S_1 formation with carbonate-sand-shale and carbonate-effusive-terrigenous facies of the Lower Silurian; terrigenous-volcanogenic, tuffaceous-terrigenous, sand-shale facies and facies of boulder-pebble siltstones of the Middle-Upper Ordovician; 2) carbonate (S_1-D_2) formation with dolomite, siliceous-carbonate, limestone facies of the Upper Devonian; limestone and limestone-dolomite facies of the Lower Devonian age; limestone, limestone-dolomite and dolomite facies of the Lower-Middle Silurian; limestone, siliceous-limestone and siliceous-tuffaceous-limestone facies of the Lower Silurian; 3) effusive-carbonate-terrigenous (S_2-D_{1-2}) formation with carbonate-terrigenous and effusive-terrigenous facies. The composition of the first is sericite, carbonaceous-siliceous shales, siltstones, polymictic sandstones, less often dark gray gravelstones and conglomerates, lenses of limestones, dolomites and carbonate rocks with terrigenous admixture. The composition of the second is quartz-micaceous, carbonaceous shales, with interlayers of quartzites, quartzite-like sandstones, metaandesite-basalts and their tuffs; 4) porphyritic-schlirian (C_1) with carbonate-terrigenous and terrigenous-volcanogenic facies. The former contains siltstones, sandstones, and aleuropelites of dark gray color, massive, sometimes in flyschoid interbedding; pelitic limestones and banded and webbed dolomites. The second facies consists of dark gray siltstones, quartz-mica shales, dacitic and liparitic porphyries, andesite-dacites and their tuffs; tuffaceous-sedimentary breccias; 5) molasse (C_2), consisting of alternating conglomerates, gravelstones, polymictic sandstones, siltstones, quartz-mica shales of dark gray and black colors (Stratified and intrusive formations of Uzbekistan, 2000).

RESULTS AND DISCUSSION

As a result of the statistical metallogenic analysis of the Zirabulak-Ziaetdin region, the following was obtained: 1) the total number of ore objects is 116 units; 2) They are quantitatively distributed as follows: gold ore and gold-silver - 70 pieces, polymetallic (copper, lead, zinc, silver, antimony, tin, bismuth, etc.) - 32, tungsten (associated gold, tin, copper) - 5.

The most promising for gold mineralization is the Katarmai Formation, in which a thick (up to 4.5 km) volcanic-quartzite-slate stratum is distinguished, conditionally assigned to the Lower Devonian (Kustarnikova, 2012). It contains 4 subformations. The high ore content of the region is determined by the discovery on its territory of industrial deposits of silver, tungsten, tin, copper, uranium, etc. (Sadikova, 2021; Turesebekov, 2021).

In the Zirabulak-Ziaetdin mountains, there is also a very large number of discontinuous faults in the northeast direction. They are observed almost throughout the region. Faults in the northwestern direction are interformational, develop at the contact of formations of different ages. Such faults are concentrated mainly in the Ziaetdin Mountains, where the northwest strike of all stratigraphic units is observed. The fault zone is represented by intensely crushed, mylonitized, kaolinized, clarified, sericitized and, partially, silicified rocks. The weak mineralization of tin, gold and tungsten is confined to the fault zone. As a result, a computer analysis was performed according to the method of F.A. Usmanov in ArcGIS 10.8 (2002, 2005).

First, we consider the placement of precious metal objects in the buffer zones of the faults of the Zirabulak-Ziaetdin mining region. To do this, we built fault buffer zones with a radius of 2 km, prepared a mineral map with precious metal objects, and performed a recalculation. As a result, a scheme for the placement of precious metals in the buffer zones of the Zirabulak-Ziaetdin mining region was obtained (Fig. 1), a diagram for this scheme (Fig. 2).

The diagram shows that most precious metal objects are concentrated in the buffer zones of sublatitudinal (about 35% of the total number of precious metal objects) and northeastern (about 33%) strike faults. Further, about 19% of the objects are concentrated in the buffer zones of the northwestern direction; about 11% of the objects are located in the buffer zones of the submeridional direction; and only about 3% of precious metal objects are located in the buffer zones of the west-north-west direction.

CONCLUSION

1. In Zirabulak-Ziaetdin region, according to the results of statistical metallogenic analysis, the following was obtained: 1) the total number of ore objects is 116 units; 2) quantitatively distributed as follows: gold ore and gold-silver - 70 pieces, polymetallic (copper, lead, zinc, silver, antimony, tin, bismuth, etc.) - 32, tungsten (associated gold, tin, copper) - 5.
2. A feature of the structural control of gold deposits is a clear connection of mineralization with large zones of disturbances of the regional plan and an uneven distribution and combination of faults in various directions and orders, expressed by various dislocation forms (zones of schistosity, crushing). As a result, the degree of fragmentation of rocks along the fault zones has a linear local character. This leads to varying degrees

of rock permeability within fault zones.

3. Thus, we can state that the ore-bearing factor (C) is higher for faults with northeastern (C = 0.1), submeridional (C = 0.09) and sublatitudinal (C = 0.07) directions.

4.

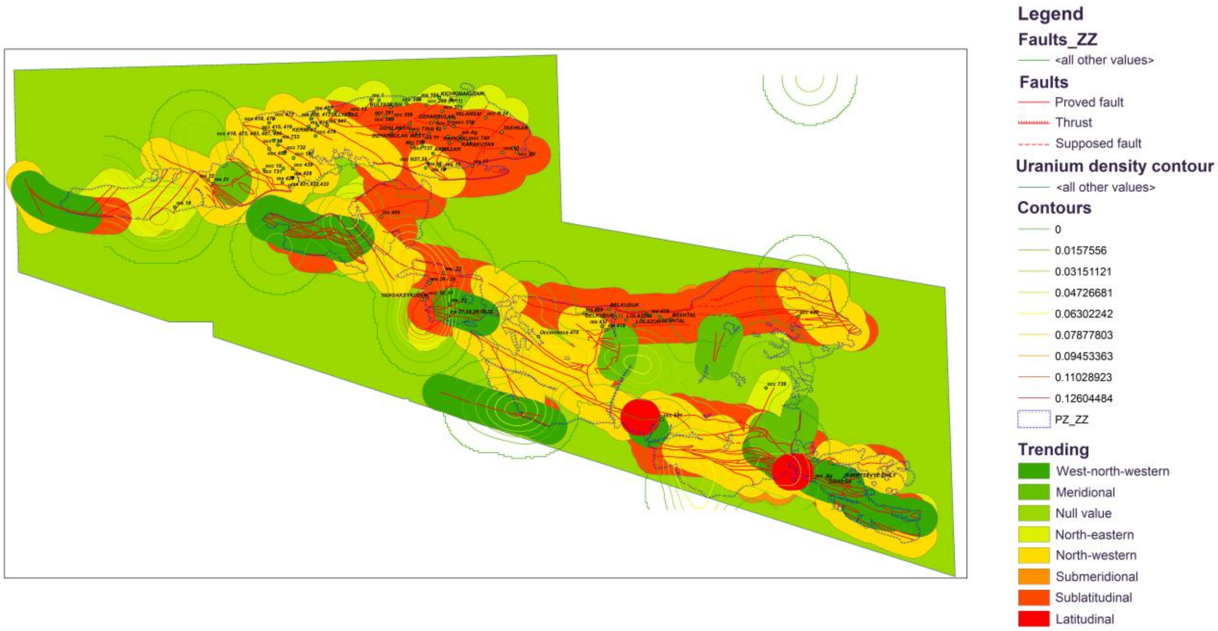

Figure 1: Scheme of distribution of objects of precious metals in the buffer zones of faults of the Zirabulak-Ziaetdin mining region

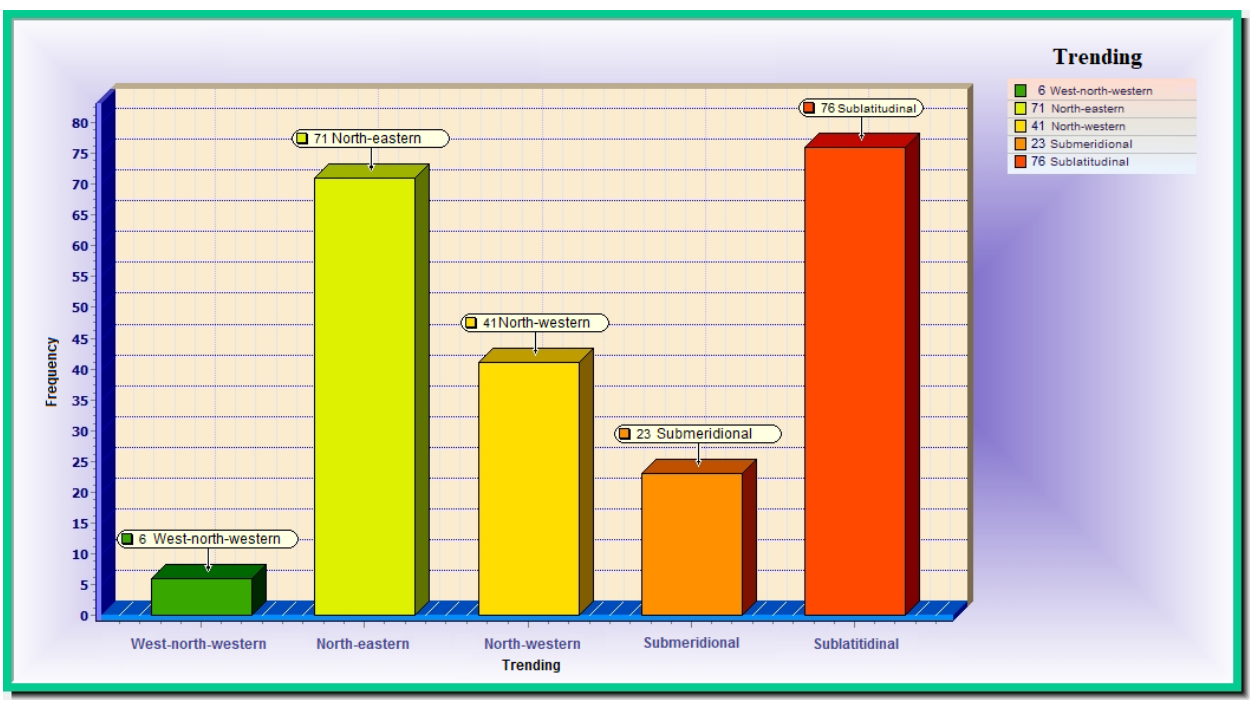

Figure 2. Diagram of the frequency of occurrence of precious metal objects in the buffer zones of faults in various directions

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